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[54] **PROCESS AND APPARATUS FOR COOLING HOT BRIQUETTES**

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[51] **Int. Cl.** **F26b 7/00**

[58] **Field of Search** 34/13, 20, 64, 65, 34/79; 201/169, 174, 39; 202/228

[56] **References Cited**

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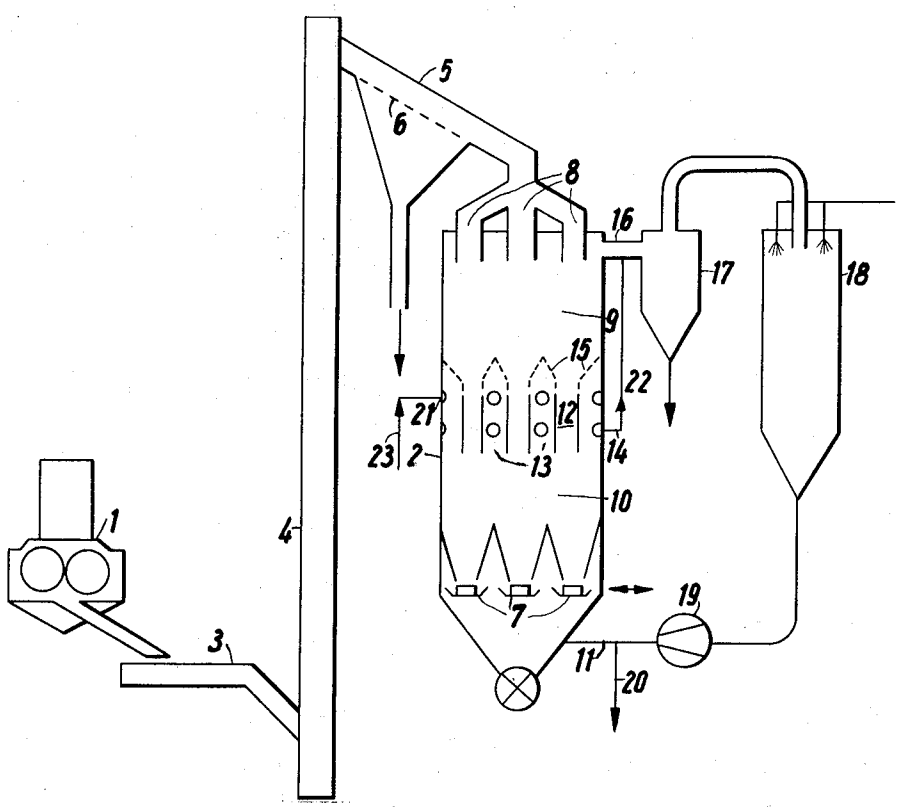
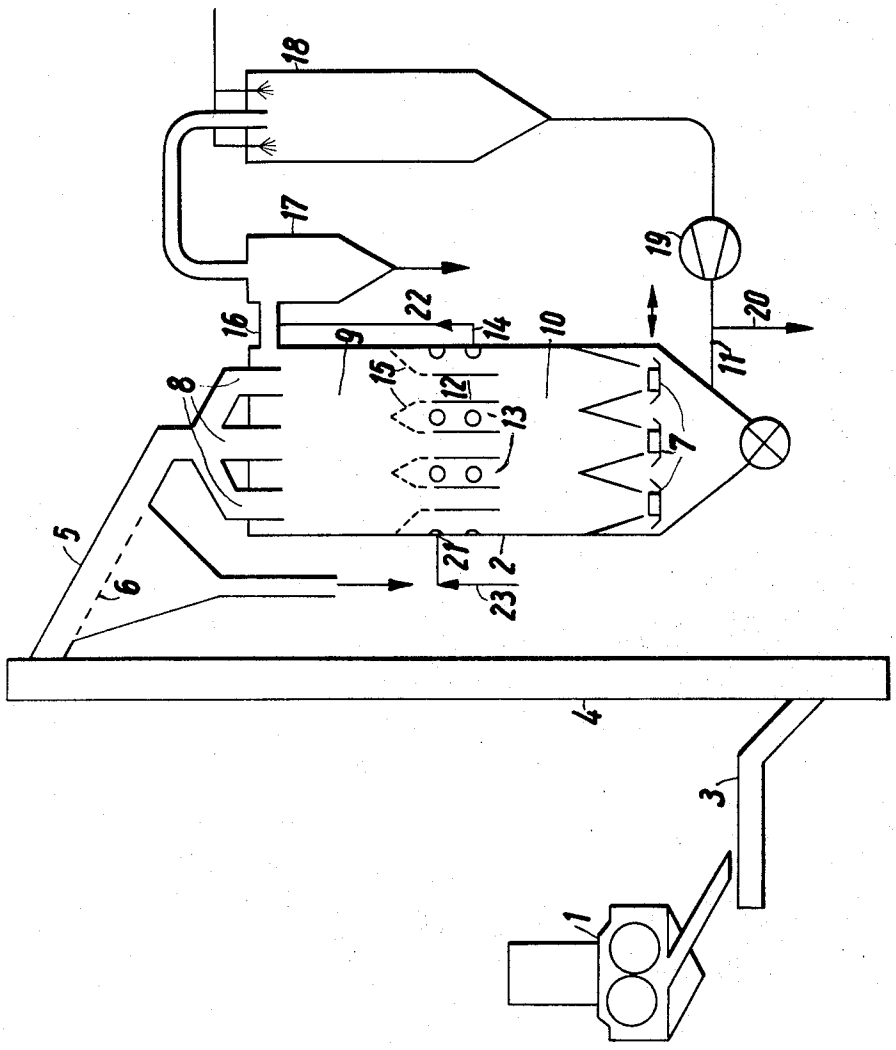
[57] **ABSTRACT**

Hot briquettes travel through a shaft cooler as a packed layer under the force of gravity and countercurrent to a stream of cold inert gas. A partial stream of cooling gas is withdrawn laterally from the upper half of the cooler and is recycled.

6 Claims, 1 Drawing Figure

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PROCESS AND APPARATUS FOR COOLING HOT BRIQUETTES

BACKGROUND

This invention relates to process and apparatus for cooling hot briquettes made from fine-grained coke and fine caking coal at a temperature in the range of 400°–550°C., by means of an inert gas in a shaft through which the briquettes travel continuously under the action of gravity.

The hot briquettes produced in this manner still contain 0.2–0.6 percent by weight of tar but burn virtually without smoke. Owing to this property, the hot briquettes may be used without subsequent coking as domestic fuel which burns without a formation of soot, and also as reducing coke in a blast furnace. Investigations have shown that the hot briquettes must be subjected to different treatments, depending on the nature and caking capacity of the coal employed and on the properties of the hot coke, particularly the porosity thereof, if hot briquettes are to be obtained which have an optimum crushing strength and abrasion resistance and a minimum tar content and which meet the essential requirements for reducing coke in blast furnace processes.

DOS 1,915,905 discloses a process in which the hot briquettes must be kept at or below the pressing temperature for a predetermined time, which depends on said temperature. A relatively long aftertreatment of at least 30 minutes is required. The hot briquettes are preferably treated intermittently in two shafts, which are filled in alternation. After the treatment for the predetermined time, the hot briquettes are cooled quickly.

Hot briquettes are preferably made by pressing caking hard coal with an addition of non-softening solids, particularly fine-grained coke, in the plastic range of the hard coal at temperatures between 400° and 540°C. The coke is heated to such a high temperature that the mixture of coke and of the caking coal, which has been predried and, if desired, preheated, assumes a mixed temperature in the range of 400° to 540°C. and the mixture is charged at this temperature to the briquetting press. The ratio of coke to caking coal varies in wide ranges, in dependence on the nature and the caking capacity of the hard coal which is used and mainly on the porosity and the strength of the hot coke. Ratios of 60–75 percent by weight of coke to 40–25 percent by weight of caking coal are usual. The mixed temperature is preferably maintained in the range between 440° and 520°C. and particularly between 460° and 480°C.

SUMMARY

The invention relates to a process of cooling hot briquettes made from fine-grained coke and fine caking coal at a temperature in the range of 400°–550°C. by means of an inert gas in a shaft through which the briquettes travel continuously under the action of gravity.

According to the invention the hot briquettes travelling through the shaft cooler are moved as a packed layer countercurrent to a cold inert gas stream to contact the same, and a partial stream is laterally withdrawn from the inert gas stream in a cross-section of the upper half of the shaft.

DESCRIPTION OF THE DRAWING

The present invention will be more fully understood by reference to the accompanying drawing wherein

preferred apparatus of the invention is diagrammatically illustrated, said apparatus being suitable for carrying out the process of the invention.

DESCRIPTION

The invention combines the effective cooling with a thermal aftertreatment of the still hot briquettes.

The rate of the inert gas which flows countercurrent to the hot briquette charge to cool the same is reduced in the upper half of the shaft, preferably at a point between one-half of the height of the shaft kiln and the upper one-third thereof. The partial stream which is laterally withdrawn from the upper half of the shaft and the residual stream which is withdrawn from the top of the shaft cooler are jointly subjected to dust collection and cooling and returned to the discharge end of the shaft cooler, where they are reintroduced into the charge. The cooled recirculated gas for precooling the hot briquettes may be at a temperature between 30° and 200°C. as it enters the shaft cooler. Where steam is used, the same should have a temperature above 100°C. whereas lower temperatures may be adopted where, e.g., flue gases are employed.

The cold inert gases which are introduced are heated as they rise through the descending briquette charge, which is cooled at the same time. When the inert gas has passed through about two thirds of the charge in the shaft, part of the inert gas is branched off and laterally withdrawn from the shaft cooler.

It has also been found that with certain coals used in the making of the briquettes, heating of the hot briquettes by about 50°C. to 100°C. above the briquetting temperature considerably increases the strength and reduces the tar content of the hot briquettes. In any case, a treatment for a limited duration at a temperature which is slightly above the pressing temperature and a subsequent, initially slow cooling are desirable for an increase of the crushing strength and abrasion resistance of the hot briquettes.

For such treatment, hot inert gas which is at a temperature which is 50°–100°C. above the briquetting temperature is introduced into the shaft cooler above the lateral branch for laterally withdrawing the partial stream. This introduction of hot gas raises the temperature of the hot briquettes by 25° to 75°C.

The residence time of the hot briquettes in this heating zone is generally 10–20 minutes whereas the residence time in the cooling zone is 20–40 minutes.

The gases to be recirculated are withdrawn at the end where the hot briquettes are charged and together with the partial stream withdrawn from the lower part are subjected to dust collection, subsequently cooled, and reintroduced into the lower part of the shaft cooler.

The hot briquettes leaving the shaft cooler may be quickly aftercooled to eliminate the risk of self-ignition. This aftercooling may be accomplished in various ways, including, for instance, by an aftertreatment with water, which may be sprayed, or in dip basins, as well as by a cooling with air alone.

The process and apparatus according to the invention will be explained more fully and by way of example with reference to FIG. 1.

The hot mixture is pressed in a double-roll press 1 and in the form of hot briquettes enters a shaft cooler 2.

Depending on local conditions, the hot briquettes made in the double-roll press 1 are first carried by a

horizontal conveyor **3** and are subsequently raised, e.g., by means of a vertical elevator **4,** to the level of a feed chute **5,** from which they flow to the shaft cooler **2.** The chute **5** is suitably provided with a grate or screen **6,** through which fines abraded from the briquettes and any undersize briquettes are discharged.

The hot briquettes travel as a packed charge through the shaft cooler **2** from top to bottom. A discharge valve **7** is controlled so that the shaft cooler is always filled up to the distributing chutes **8.**

In the upper part **9** of the shaft cooler **2,** the briquettes are slowly cooled or heat-treated whereas they are progressively cooled in a lower part **10.**

The cooling is accomplished by circulating gases, which at a temperature of 30°–200°C., e.g., of 130°C. enter through the conduit **11** into the lower part of the shaft cooler and flow through the same from bottom to top. They cool the hot briquettes and heat themselves almost to the temperature of, e.g, 500°C., at which the hot briquettes enter the lower part.

The lower part **10** and upper part **9** of the shaft cooler are separated by cells **13,** which are regularly spaced apart by spaces **12,** through which the hot briquettes descend. The inert gas flows preferentially through the empty cells **13,** in which a partial stream is branched off and is laterally withdrawn through **14.** Heated gases, such as flue gases at a temperature of, e.g., 900°C., may be supplied from a conduit **23** through inlets **21** disposed above withdrawing means **14** and are mixed with the remaining stream of the cooling gas to assume a mixed temperature which is about 50°–100°C. above the briquetting temperature, e.g., at 550°C., and subsequently flow through outlet openings **15,** preferably in the form of slots, from the several cells **13** into the upper part **9** of the shaft cooler.

The gases heat the hot briquettes in the upper portion **9** to a temperature which is about 25°–75°C. above the temperature at which hot briquettes enter the shaft cooler, e.g., to a temperature of 530°C. This result in a transformation of the coke structure formed by the caking coal so that the strength of the briquette structure is increased.

The gases leave the upper part of the shaft at a temperature of, e.g., 500°C. through the manifold **16** and together with the branch stream from the openings **14** and the conduit **22** flow through a cyclone **17** for a collection of the entrained dust and subsequently through a cooler **18** and are then forced back into the shaft cooler **2** by means of a blower **19.** Surplus gas is discharged from the cycle through a conduit **20.**

The cooler **18** may consist of a waste heat boiler for a generation of steam, or of a water-evaporating spray cooler or an indirect air or water cooler.

The process according to the invention and the apparatus for carrying out the process afford the advantage that the optimum conditions for the aftertreatment of hot briquettes can be adjusted in each case. Where the invention is used, the temperature profile of the cooling operation may be so designed, depending on the properties of the caking coal, its mixing ratio to the hot coke, and the temperature at which the hot briquettes have been pressed, that briquettes having an optimum crushing strength and abrasion resistance are obtained. By a control of the rate and temperature at which the gases are introduced and are withdrawn in separate streams, the temperature profile of the cooling operation can be adjusted to match any property of the hot briquettes.

What is claimed is:

1. Process for heat treating and cooling hot briquettes made from fine-grained coke and fine caking coal at a temperature of 400°–550°C. which comprises continuously passing a packed layer of said hot briquettes under the action of gravity through a shaft zone, feeding into the lower part of the shaft zone countercurrent to the briquettes a cold inert gas stream, withdrawing a partial stream laterally from said inert gas stream in a cross-section of the upper half of the shaft zone, and introducing hot flue gas above the cross-section where said partial stream is withdrawn to produce a mixture of gases having a temperature higher than the temperature of said hot briquettes.

2. Process of claim **1** wherein gases withdrawn from the top of the shaft zone are combined with said laterally withdrawn partial stream, cooled and recirculated to the lower part of the shaft zone.

3. Process of claim **1** wherein the amount of hot flue gas introduced corresponds to the amount of said cold inert gas withdrawn as said partial stream.

4. Process of claim **1** wherein said mixture of gases has a temperature which is up to 100°C. higher than the temperature of the hot briquettes.

5. Process of claim **1** wherein the residence time of the briquettes in the shaft zone above the point where said hot flue gases are introduced is one-half or less of the residence time below said point, the total residence time in said shaft zone amounting to 30–60 minutes.

6. Apparatus for heat treating and cooling hot briquettes which comprises shaft cooler means having means for feeding hot briquettes to the top thereof, means for feeding inert cooling gases to the bottom thereof, a plurality of cells having gas permeable top means positioned in said shaft cooler between the upper and lower portions thereof, each of said cells having gas outlet means for laterally withdrawing a partial stream of said cooling gases and, above said outlet means, gas inlet means for introducing hot flue gas into said shaft cooler means, said shaft cooler means having means for discharging gases at the top thereof.

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